

Nebraska Space Grant Consortium
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Consortium URL: ne.spacegrant.org
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PROGRAM DESCRIPTION

The National Space Grant College and Fellowship Program consists of 52 state-based, university-led Space Grant Consortia in each of the 50 states plus the District of Columbia and the Commonwealth of Puerto Rico. Annually, each consortium receives funds to develop and implement student fellowships and scholarships programs; interdisciplinary space-related research infrastructure, education, and public service programs; and cooperative initiatives with industry, research laboratories, and state, local, and other governments. Space Grant operates at the intersection of NASA's interest as implemented by alignment with the Mission Directorates and the state's interests. Although it is primarily a higher education program, Space Grant programs encompass the entire length of the education pipeline, including elementary/secondary and informal education. The Nebraska Space Grant Consortium is a Designated Consortium funded at a level of \$575,000 for fiscal year 2013.

PROGRAM GOALS

Goal 1: To deliver a fellowship program that offers aerospace-related research opportunities to diverse student populations at Space Grant academic affiliates throughout Nebraska. Contribute to the STEM workforce pipeline by providing a progression of educational opportunities for talented Nebraska students, preparing them to pursue careers in aerospace science and industry.

Select Goal 1 Outcome Indicators:

- 100% of active academic affiliates will receive at least 1 fellowship each year.
 - 92% as Hastings College students are not eligible
- 70% of student fellowships will result in at least 1 publication or presentation.
 - Data is still being collected as period of performance has not ended
- A minimum of 5 interns placed each year.
 - At least 6 interns will be placed this year
- At least 2 new courses related to aerospace science and engineering are developed each year, and 5 courses are revised to enhance NASA-related content.
 - At least 1 new course and 6 revised courses; the period of performance has not ended
- Support at least 5 teams of Nebraska students engaged in aerospace-related competitions each year.
 - At least 7 teams supported this year

- Develop and implement 3 new programs over the next five years for a progression of STEM opportunities for faculty and students.
 - At least 3 new programs implemented
- 45% of Space Grant significant awardees who graduate and enter the workforce as their next step, will be employed by NASA, aerospace contractors, universities, or other educational institutions.
 - 75% of those who graduated and entered the workforce are employed in STEM aerospace, and 25% are employed in STEM non-aerospace
- 45% of Space Grant significant awardees who graduate will pursue advanced education in NASA-related disciplines.
 - 56% of those graduating are pursuing advanced STEM degree
- Awards to women and minorities meet or exceed the state enrollment percentages in STEM fields.
 - 42% female, 13.6% underrepresented
- 50 underrepresented students will be served in the higher education programs.
 - At least 23 underrepresented students; data is still being collected

Goal 2: To raise the aggregate quality and quantity of Nebraska's aerospace research endeavors to the highest level of national competitiveness.

Select Goal 2 Outcome Indicators:

- 90% of research mini-grant awards will be endorsed by a NASA collaborator, or aligned with the NASA Vision, Mission Directorates, or NASA Center priorities.
 - 58% had a NASA partnership, and 100% were aligned with NASA's vision, Mission Directorates, or NASA Center priorities
- 75% of research mini-grant awards will include at least 1 student research experience.
 - 92% included a student research experience
- 60% of student researchers will pursue a higher academic degree in a STEM-related field, or employment in a STEM-related field following their research experience.
 - Data provided above
- 50% of funded researchers will submit an application for continued funding of their research elsewhere.
 - 83.3% of researchers submitted a proposal
- At least 1 publication will result from each funded project.
 - To date, 66.7% of research projects resulted in a publication, although the period of performance has not ended

Goal 3: To strengthen the Nebraska STEM education base from elementary through university levels with emphases on NASA content, teacher training, and delivery to underrepresented groups.

Goal 3 Outcome Indicators

- Support 4 teacher workshops each year that offer NASA content-based education resources or demonstrate how to incorporate NASA resources in the classroom

- Through the NESA program alone, more than 24 presentations have been delivered
- Engage 1,000 Nebraska K-12 students annually
 - At least 1,552 students have been engaged

Goal 4: To increase public support for NASA through informal education and spreading NASA's mission to Nebraska citizens and beyond.

Goal 4 Outcome Indicators

- Support at least 3 informal education activities per year that align with NASA's informal education goals and required criteria, with priority to those activities that: 1) target underrepresented students; 2) provide professional development opportunities for informal education provider; or 3) incorporate NASA data or NASA materials for programs and exhibits.
 - At least 5 information education activities were supported
- At least 50 families participate in the Native American Family Science program at Nebraska's tribal schools to enhance learning and inspire higher performance in STEM-related studies.
 - At least 50 families participated through the 2 star parties

PROGRAM/PROJECT BENEFIT TO OUTCOME (1,2, & 3)

Provide concise, meaningful highlights or anecdotes (no more than three) that are directly related to work completed in 2013, highlighting student and/or project accomplishments. Specify alignment to an Outcome.

Outcome 1: Dr. Dennis Alexander's research seeks to enhance and optimize bubble production during nucleate boiling using novel laser-processed surface structures with micrometer and nanometer roughness. He is addressing the critical issue of the service structure permanency through the use of Femtosecond laser surface processing to directly modify surface properties and to achieve stability at high temperatures. This approach avoids the deposition of additional materials, which have proven to lack permanency at high temperatures. Their contact at NASA's Glenn research Center says the fabrication of permanent structures constitutes a breakthrough technology across many relevant applications. The preliminary results have caught the attention of their industrial partner, the Nebraska Public Power District, who has arranged for a visit to his UNL lab by the Electric Power Research Institute to explore collaborative research.

Outcome 1: NASA fellow Allison Miller, a sophomore at UNL, participated in the Robo Ops team which designed and competed a Mars rover in NASA's competition. The rover was built from the ground up and integrated mechanical, electrical, and communication systems such as a mechanical arm and the ability to communicate with the rover over long distances. She found the hands on experience extremely valuable because it allowed her to apply the theoretical classroom knowledge to a real world application. The fellowship gave her the opportunity to work with graduate students who had more design experience than she did. They helped her better understand the engineering design process. She believes her fellowship gave her a head start in engineering because it

allowed her to immerse herself in the engineering design process that most of her classmates had not yet done. Allison will be spending the summer of 2014 at NASA Ames Research Center as a Space Grant intern.

Outcome 2: In an effort to increase the skills of STEM educators in Nebraska and to implement quality NASA content into teacher workshops being conducted in the state, the NASA Nebraska Space Grant implemented a new Nebraska Education Space Ambassadors program. Twenty Nebraska in-service and pre-service teachers were trained by a NASA Kennedy Space Center's education staff in authentic NASA content to bring back and deliver across the state throughout the rest of the year. To date, these teachers have delivered more than 24 presentations to at least 401 teachers, impacting more than 847 students across Nebraska. The teachers will receive advanced training this summer at the Nebraska Star Party where they will explore advanced telescope optics and other astronomy lessons.

PROGRAM ACCOMPLISHMENTS

Refer directly to the consortium goals and SMART objectives in your 2010 base proposal when describing your accomplishments.

Outcome 1: *Contribute to the development of the STEM workforce in disciplines needed to achieve NASA's strategic goals: (Discussion of achievements and progress related to your Fellowship/Scholarship, Higher Education and Research Infrastructure programs). (Employ and Educate)*

Some success stories this year include:

Beginning in the fall of 2014, the UNL College of Engineering will be offering a new minor in Robotics Engineering, incorporating courses from several college areas. The minor is available for students on the Lincoln and Omaha campuses. This new minor is directly related to the numerous NASA activities at UNL.

Two Nebraska Space Grant students, Joe Bartels and Corey Kruse, were selected for the NASA Space Technology Research Fellowships (STRF) in the spring of 2014. Joe has worked with Dr. Shane Farritor and was president of the AIAA club where he started many of the student led NASA projects that continue to this day. Corey worked as a Space Grant Fellow with Dr. George Gogos on his research directly related to the Femtosecond laser surface process for thermal management systems. His STRF is funded in this area.

The Nebraska Space Grant is partnering with female student groups to foster more participation from women in the fellowship program and in student-led competition teams. The UNL Chapter of the Society of Women Engineers and UNO's Women in STEM group are just two examples.

Dr. Ann Fruhling, UNO, is working to leverage the technology expertise and infrastructure from the Microbiology Emergency Response and Consultation system (STATPack) that we have developed and deployed for the Nebraska Public Health

Laboratories so that it can support astronauts in space should they have a medical event that requires microbiology consultation and diagnosis.

There are very few cosmic ray muon radiography detectors in the world and they are used to image the interior of volcanoes. Dr. Kendra Sibbernson, Metropolitan Community College, is working on building such a detector as such devices could possibly be deployed on other planets or moons to image the insides of large-scale features. Dr. Sibbernson held a workshop where community college students partnered with UNL students to learn about High-Energy particle physics and how scintillators detect muons. The students developed scientific research projects based on using the detectors.

Outcome 2: *Attract and retain students in STEM disciplines through a progression of educational opportunities for students, teachers, and faculty:* (Discussion of achievements primarily focused on your Higher Education programs not discussed in Outcome 1 and your Precollege programs). (*Educate and Engage*)

The public education system in the state of Nebraska has continually been outranked in academic performance in STEM. Currently, only 69% of Nebraska students are proficient in STEM education, and students from low socioeconomic households and those of migratory families show proficiencies of only 13%. To address these issues, Dr. Christine Cutucache, UNO, created an after school time program entitled NE STEM 4U. This program provides after school STEM instruction to youth on free and reduced lunches in the Omaha Public Schools (OPS) district. These issues are of high priority to NASA to ensure a talented workforce in future years. We aim to bridge the opportunity gap to provide quality, educational after school activities focused on STEM in OPS. An added benefit to the educational component is a mentorship role for which UNO NE STEM 4U students serve to OPS students through this program. This program is unique in that it provides an added leadership and training opportunity for UNO students as they plan experiments, teach K-12 students, and subsequently develop their own communication and critical thinking skills. Therefore, not only are K-12 students benefitting from outside instruction in STEM, but UNO undergraduate students gain an added leadership opportunity and the opportunity to participate in a learning experience outside of the classroom that also makes an impact on their community.

The UNL 4-H wearable technologies project seeks to develop the next generation workforce by combining computing, engineering design, and textiles. This multidisciplinary approach to stem teaching and learning is being piloted with middle school students through after-school workshops and activities to engage the students in learning and how to use their own skills to solve engineering problems.

The NASA Nebraska Space Grant supported the College of St. Mary (CSM) Elementary Science Outreach Program in which CSM students developed and delivered engaging science activities to elementary students designed to stimulate interest in the STEM fields. To date this year, 11 CSM students participated in 12 outreach activities, serving 410 K-4 students, and 24 teachers.

Two tribal college faculty members from Little Priest Tribal College mentored six undergraduate students in an effort to use GPS technology to map sightings of mountain lions and arrowhead plants on the Winnebago Reservation of Nebraska. They utilized NASA mapping and data imagery curriculum to assist students in applying these techniques for the dual purpose of educating the community about these native species and pursuing questions relevant to NASA.

Outcome 3: *Build strategic partnerships and linkages between STEM formal and informal education providers that promote STEM literacy and awareness of NASA's mission:* (Achievements and progress of Informal Education programs). (*Engage and Inspire*)

Dr. Ken Trantham, University of Nebraska at Kearney (UNK), conducted a new public outreach, informal education seminar series in which he taught the motions of the Earth and other key ideas such as light pollution to the public. Through the project, Public Awareness of Science through Astrophotography, participants learned the science of imaging and processing with D-SLR cameras, and then discussed what can be learned from these images. He developed curriculum materials which are available on the web and also posted some photos from participants. The project was so successful he had to limit the number of participants and has plans to offer it again later this year.

The Nebraska Science Festival (NE SciFest) is a 4-day statewide celebration of STEM that includes numerous free activities and programming. Dr. Scott Tarry, Director of the NASA Nebraska Space Grant Consortium, serves on the NE SciFest Board of Directors and delivered one of the free aviation workshops for students. UNO Women in Aviation members staffed a Space Grant booth that offered free aeronautics activities to students from around the Omaha area.

Aim for the Stars Astronomy summer camps at UNO engage students in engineering and building using physics, math, and chemistry. In addition to the regular camps, this year a girls-only camp for astronomy was introduced in which 24 females participated. Campers learn about planets, stars, and moons in the UNO planetarium. Other topics include: discovering how gravity binds solar systems together or tears them apart, telescopes and lenses, and even rocketry for the younger campers.

Math Alive!, an interactive exhibit focusing on the many ways math is part of life, was available to the public at the Strategic Air & Space Museum in late 2013. The exhibit also provided a number of opportunities for teaching training. UNO mathematics and STEM education professors held workshop sessions at the museum to show pre-service and in-service teachers how to use concepts presented in the exhibit to bring math alive for their own students.

PROGRAM CONTRIBUTIONS TO NASA EDUCATION PERFORMANCE MEASURES

- **Student Data and Longitudinal Tracking:** Number of program student participants employed by NASA, aerospace contractors, universities, and other educational institutions; Number of undergraduate students who move on to advanced education in NASA-related disciplines; Number of underrepresented and underserved students participating.

Total Significant Awards: 66; Fellowship/Scholarship: 29; Higher Education/Research Infrastructure: 37. Nine of the awards were directed to underrepresented minorities. Most students (57) are still enrolled in their current degree program. Five students have graduated and are pursuing advanced STEM degrees, three students are employed in the aerospace workforce, and one student is employed in the non-aerospace STEM workforce.

- **Minority-Serving Institution Collaborations:** Summarize interactions. Reference the names of projects with MSI collaborations.
 - The NASA Nebraska Space Grant continues to work with the two tribal colleges in the state: Little Priest Tribal College (LPTC) and Nebraska Indian Community College (NICC). Two joint star parties were held at LPTC: one for the Winnebago Reservation community and the other for LPTC students. Planning for these star parties led to a new relationship with Math and Science faculty member Jessie Antonellis. Ms. Antonellis was also revising the math and science curriculum at LPTC. She created a BioMath lab course and the students enrolled in this new course were encouraged to participate in a research project that was important to the community and relevant to STEM. NICC expanded on a previously funded project to engage more students in research. Last fall we funded three fellowships for students working on a climate change project relevant to their community. Projects funded this year include: Mapping Native Species of the Winnebago Reservation (Sarah Alvarado, LPTC, Fellow; Kayleen Blackhawk, LPTC, Fellow; Craig Cleveland Jr., LPTC, Fellow; Christian LaPointe Sr., LPTC, Fellow; Karen Scott, LPTC, Fellow; Roger Whitebear, LPTC, Fellow); Comparing Local Weather Monitoring Data with Historical Records (Breanna Bickerstaff, NICC, Fellow; Donald Pike III, NICC, Fellow; Sarah Zavala, NICC, Fellow); Little Priest Tribal College Community Star Party; Little Priest Tribal College Student Star Party.
- **NASA Education Priorities:** *Accomplishments related to the “Current Areas of Emphasis” stated in the 2010 Space Grant solicitation. Report on areas that apply to work proposed in your proposal and budget.*
 - Authentic, hands-on student experiences in science and engineering disciplines – the incorporation of active participation by students in hands-on learning or practice with experiences rooted in NASA-related, STEM-focused questions and issues; the incorporation of real-life problem-solving and needs as the context for activities.

Perhaps one of the most prevalent concerns among astronauts and their peers with regard to space exploration is the sudden chance of a medical complication without being in proximity of medical personnel who could immediately assist them, especially on long-

distance missions. The Nebraska Microgravity team is currently working on a device which will aid in addressing these concerns. The team's solution is robotic capsule endoscopy (RCE). This procedure would call for a robotic capsule capable of delivering a biosensor into an astronaut intestinal tract to monitor their health for long spans of time. The team foresees RCE technology advancing to noninvasive surgical ability on astronauts with the use of on board miniature tools. The team will receive NASA curriculum and training at Johnson Space Center during flight week in June 2014.

Some additional hands-on activities include:

RockSat-X EHD Thin Film Boiling in Microgravity and 3D Printed Circuits

Design, Build, Fly Team

Intercollegiate Rocket Engineering Competition Team

Robotic Mining Competition Team

Mars Rover 2.0 Robo Ops Competition

RockOn!

Autonomous Vehicle Competition

- Diversity of institutions, faculty, and student participants (gender, underrepresented, underserved).

As mentioned above, we are continuing our projects with the two Nebraska Tribal Colleges, both of which are affiliates of the NASA Nebraska Space Grant. Another affiliate, the College of St. Mary, is a female only institution. We have a diverse composition of affiliates, including 4 community colleges, 3 Ph.D. granting institutions, and 4-year state and private colleges. Our affiliates are located statewide, including the underserved panhandle of Nebraska. To date in FY 13, 38.5% of the fellowship awards were to females (the number is over 40% when including Higher Education and Research students) and 20.5% to underrepresented students. Through our fellowship program, we strongly encourage women, minorities, and persons with disabilities to apply. Recently, our office has made several trips to both of the Tribal Colleges to encourage a more diverse pool of applicants for our upcoming fellowship deadline.

- Engage middle school teachers in hands-on curriculum enhancement capabilities through exposure to NASA scientific and technical expertise. Capabilities for teachers to provide authentic, hands-on middle school student experiences in science and engineering disciplines (see above).

In addition to the Nebraska Education Space Ambassadors program mentioned above, faculty at Chadron State College implemented a new project where STEM majors mentored pre-service teachers. The science mentors assisted the pre-service teachers in advancing their comfort level with science. The project included hands-on and training experiences for the teachers (4 hours a week for 10 weeks), a partnership between Chadron State College and Chadron Public Schools, curriculum sharing through outreach in the local after school program, and an interdisciplinary approach to STEM and pre-service education.

- Community Colleges – develop new relationships as well as sustain and strengthen existing institutional relationships with community colleges.

This year we initiated a new community college partnership which includes the Avenue Scholars Foundation and Metropolitan Community College. Avenue Scholars works with at risk students in seven Omaha-area high schools. These students have GPAs of 2.5 or less, and the students qualify for free or reduced lunch. The Foundation has Talent Advisors in the high schools who work with the students in their junior and senior years. The students take classes at the community college the second semester of their senior year. NASA Nebraska Space Grant will be partnering with them to incorporate STEM content and career exploration during their bridge summer that exposes them to the STEM tracks at the community college.

Some additional community college projects include:

Autonomous Vehicle Competition

High Altitude Ballooning Course

Cosmic Ray Muon Radiography

Mapping Native Species of the Winnebago Reservation

Collecting and Comparing Climate Data on the Reservation to National and Global Data

- Environmental Science and Global Climate Change – research and activities to better understand Earth's environments.

Dr. Jing Zeng's research, Using Satellite Data to Study the Relationship between Crop Yield and Precipitation, is important research to the state as agriculture is an important part of the state economy. Precipitation and radiation are the two most important factors that decide the annual agricultural yield. Therefore, it is important to understand the seasonal and annual variations of precipitation and surface solar radiation, and the relationship between precipitation and radiation. Dr. Zeng collaborated with Dr. Christa Peters-Lidard, a physical scientist in the Hydrological Sciences Laboratory at NASA's Goddard Space Flight Center (GSFC). They are working on the evaluation of the land surface radiative flux from different observations and model outputs. Dr. Zeng also works with Dr. Yudong Tian in the GSFC Hydrological Sciences Laboratory. Together they are studying the annual variation precipitation and land surface energy balance in Nebraska using the satellite measurements and numerical models outputs.

NASA fellow Gina Gilson is pursuing an undergraduate degree in biology and environmental science at Creighton University. Her experience with the research project, Quantifying Spatial Variability of Microbenthic Algae Using Remote Spatial Technology, has influenced her decision to pursue a graduate degree. Gina was able to present her research at the Coastal Estuarine Research Federation annual meeting.

IMPROVEMENTS MADE IN THE PAST YEAR

Succinctly describe improvements and/or adjustments made last year that demonstrate significant change(s) within the consortium. The improvements and/or adjustments that brought about change may have been in management, resource allocation, project design, project evaluation, etc.

The past few years have seen many changes in our consortium. Our director returned to the university full-time after three years at the Strategic Air & Space Museum. This year we did not replace outgoing administrative staff, but will consider it over the next year as we plan for the next proposal. We are further developing our partnerships with our community college affiliates in direct response to the Space Grant solicitation issued in the spring of 2014 and the needs of the Nebraska workforce. Finally, we are building a new partnership with the UNL chapter of the Society for Women Engineers to foster more female participation in the fellowship competition and the NASA student competition teams.

PROGRAM PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

List the institutions that comprise the consortium; include the name, type of institution, key characteristics, and role.

Academic affiliates of the Nebraska Space Grant Consortium include:

- Chadron State College, 4-year public college and graduate degree granting institution
- College of St. Mary, 4-year private college, all women's institution
- Creighton University, 4-year private university and graduate degree granting institution
- Hastings College, 4-year private college
- Little Priest Tribal College, 2-year public community college, Tribal college
- Metropolitan Community College, 2-year public CC, over 110 off-site locations
- Nebraska Indian Community College, 2-year public CC, Tribal college
- University of Nebraska – Lincoln, 4-year public university and Master's and Ph.D., graduate degree granting institution, Flagship of the University of Nebraska system
- University of Nebraska at Kearney, 4-year public university and graduate degree granting institution
- University of Nebraska at Omaha, 4-year public university and Master's and Ph.D. degree granting institution, Lead institution for Space Grant
- University of Nebraska Medical Center, 4-year public university, Master's and Ph.D. granting medical institution
- Western Nebraska Community College, 2-year public CC

Industry, government, and non-profit affiliates and partners include:

- 99th Pursuit Squadron Civil Air Patrol: Offers informal aerospace education outreach targeted to underrepresented populations
- CALMIT- Center for Advanced Land Management Information Technologies: Research projects and internships in the field of agricultural remote sensing
- Girl Scouts: Offers informal aerospace education targeted to female populations
- Nebraska 4H: Projects in robotics, agriculture, and geospatial research
- Nebraska Department of Aeronautics: State government division that offers internships and projects in aeronautics

- Nebraska Department of Education: Lead organization for the Summer of Innovation grant
- Nebraska Academy of Sciences: Partner in delivering annual research conference
- Nebraska Aviation Council: Includes representatives of aeronautics industry throughout the state; developer of the Nebraska STARBASE Rocket Team
- Strategic Air and Space Museum: Foremost aviation museum in the Midwest; offers informal STEM programming
- Tuskegee Airmen: Offers internships and aeronautics outreach targeted to underrepresented populations